Geophysical Research Abstracts
Vol. 17, EGU2015-13061, 2015
EGU General Assembly 2015

An improved interface to process GPR data by means of microwave tomography

Ilaria Catapano, Antonio Affinito, and Francesco Soldovieri
Institute for Electromagnetic Sensing of the Environmental - National Research Council of Italy, Italy (catapano.i@irea.cnr.it)

Ground Penetrating Radar (GPR) systems are well assessed non-invasive diagnostic tools, which are worth being considered in civil engineering surveys since they allow to gather information on constructive materials and techniques of manmade structures as well as on the aging and risk factors affecting their healthiness. However, the practical use of GPR depends strictly on the availability of data processing tools, on one hand, capable of providing reliable and easily interpretable images of the probed scenarios and, on the other side, easy to be used by not expert users.
In this frame, 2D and full 3D microwave tomographic approaches based on the Born approximation have been developed and proved to be effective in several practical conditions [1, 2].
Generally speaking, a GPR data processing chain exploiting microwave tomography is made by two main steps: the pre-processing and the data inversion. The pre-processing groups standard procedures like start time correction, muting and background removal, which are performed in time domain to remove the direct antennas coupling, to reduce noise and to improve the targets footprint. The data inversion faces the imaging as the solution of a linear inverse scattering problem in the frequency domain. Hence, a linear integral equation relating the scattered field (i.e. the data) to the unknown electric contrast function is solved by using the truncated Singular Value Decomposition (SVD) as a regularized inversion scheme. Pre-processing and the data inversion are linked by a Discrete Fourier Transform (DFT), which allows to pass from the time domain to the frequency domain. In this respect, a frequency analysis of the GPR signals (traces) is also performed to identify the actual frequency range of the data.
Unfortunately, the adoption of microwave tomography is strongly subjected to the involvement of expert people capable of managing properly the processing chain. To overcome this drawback, a couple of years ago, an end-user friendly software interface was developed to make possible a simple management of 2D microwave tomographic approaches [3].
Aim of this communication, is to present a novel interface, which is a significantly improved version with respect to the previous one. In particular, the new interface allows both 2D and full 3D imaging by taking as input GPR data gathered by means of different measurement configurations, i.e. by using down looking systems, with the antenna located close to the air-medium interface or at non negligible (in terms of the probing wavelength) distance from it, as well as by means of airborne and forward looking systems. In this frame, the users can select the data format among those of the most common commercial GPR systems or process data gathered by means of GPR prototypes, provided that they are saved in ASCII format. Moreover, the users can perform all the steps, which are needed to obtain tomographic images, and select the Born approximation based approach most suitable to the adopted measurement configuration. Raw-radargrams, intermediate and final results can be displayed for users convenience.

REFERENCES

[1] I. Catapano, R. Di Napoli, F. Soldovieri, M. Bavusi, A. Loperte, J. Dumoulin, “Structural monitoring via microwave tomography-enhanced GPR: the Montagnole test site”, J. Geophys. Eng. 9, S100–S107, 2012.
[2] I. Catapano, A. Affinito, G. Gennarelli, F.di Maio, A. Loperte, F. Soldovieri, “Full three-dimensional imaging via ground penetrating radar: assessment in controlled conditions and on field for archaeological prospecting”, Appl. Phys. A, 2013, DOI 10.1007/s00339-013-8053-0.
[3] I. Catapano, A. Affinito, F. Soldovieri, A user friendly interface for microwave tomography enhanced GPR surveys”, EGU General Assembly 2013, vol. 15.